



Nutrient
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North Dakota NSTEPS Progress Update

June 24, 2021



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Agenda

- Review of project status / where did we leave off (TetraTech)
- Overview of next steps (TetraTech)
- Discussion on level of involvement / plan for future calls/ timing, etc.



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Work to Date

- Data compilation
- Data exploration
- Data analysis planning
- Preliminary classification analysis



Data Compilation

- Datasets
 - Nutrient data
 - Chemistry and thermal profile data
 - National Lakes Assessment data
- Filtered for surface (≤ 1 m)
- Goal: use most recent 10 years of data
- Lake Sakakawea
 - Potential source of bias
 - Could represent a gradient of lake condition
 - Not included in classification, plan to leave out of other analyses



Data Processing

IMPUTING NON-DETECTS WITH ROBUST ROS

- Assumes data come from normal or log-normal distribution
- Given detection limit, assigns new value to non-detects based on distribution

VARIABLE	NON-DETECTS	SAMPLES
Chl a	1,441	3,924
NH ₄ ⁺	4,356	11,393
NO ₂ ⁻ + NO ₃ ⁻	4,741	11,344
TKN	44	11,407
TN	4	9,112
TP	679	11,405
TSS	194	475

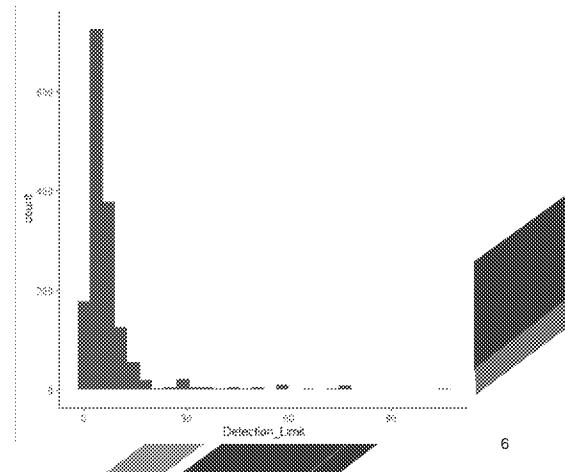


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Data Processing: Chlorophyll

FURTHER DETAILS & OUTSTANDING QUESTIONS

- Many chlorophyll samples had unusually high detection limit
- Non-detects < 3 ug/L considered "true" nondetects
- 1,549 samples below detection
- 829 "true" nondetect
- 720 removed from dataset



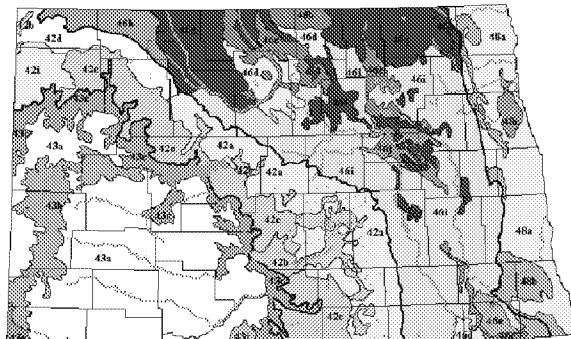
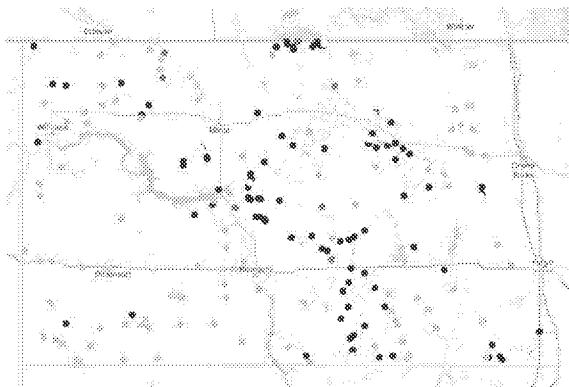
6



Lakes in ND dataset

(INCLUDES SURFACE SAMPLES DURING GROWING SEASON)

Station Type: Lake Lake (Deepest) Lake (Other) Reservoir (Deepest) Reservoir (Other)



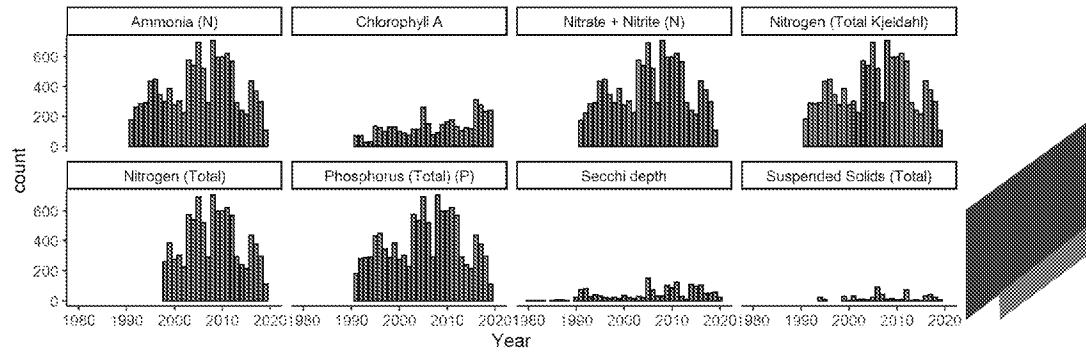


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Samples over Time

(INCLUDES ALL SAMPLES)

- Most datasets: 1990-2019
- Highest sampling densities in 2000s and 2010s

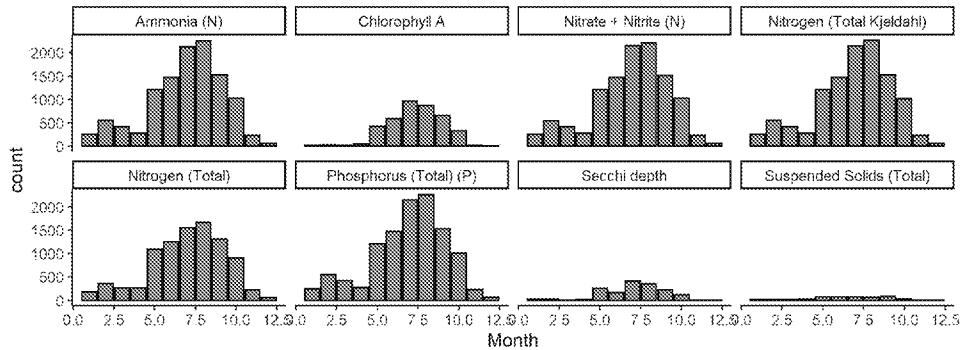


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Seasonal Counts of Samples

(INCLUDES ALL SAMPLES)

- Highest sampling densities in July & August
- Next highest in May, June, September, October

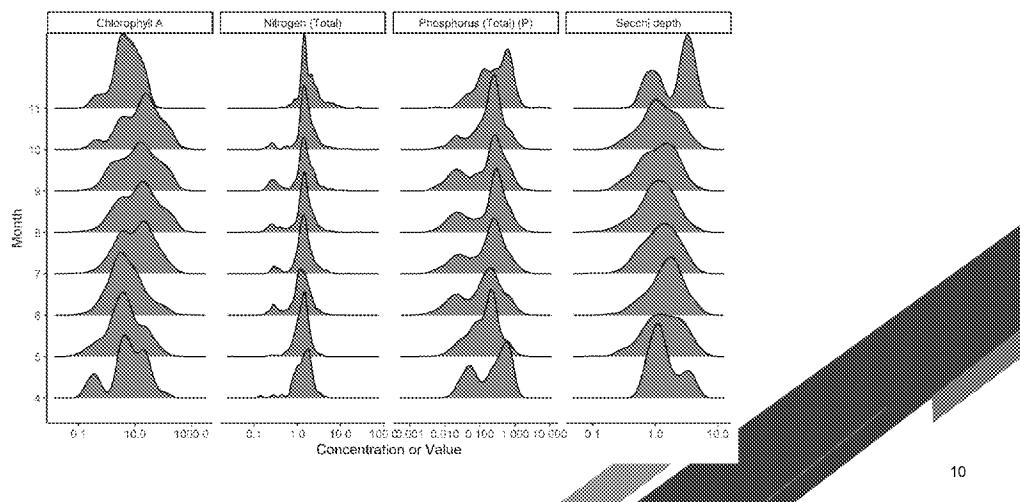




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Seasonal Distributions of Variables

(GROWING SEASON)



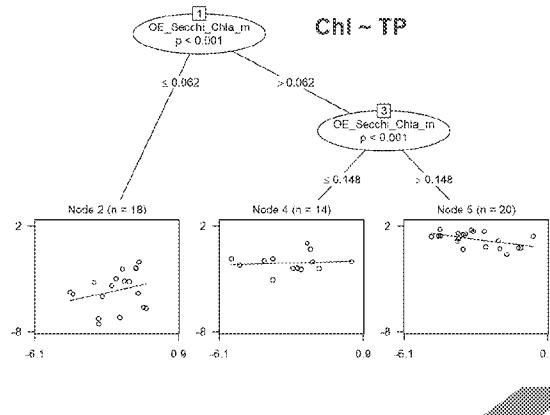


Classification analysis

- Model-based recursive partitioning (MBRP)
- Finds statistical splits in chlorophyll vs. nutrients based on classifier variables

Classification analysis

Using only most recent 10 years result in too small of a sample size

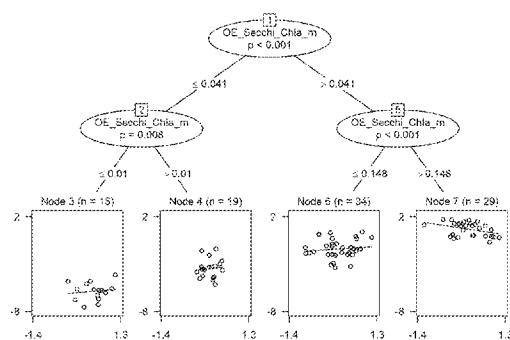


12

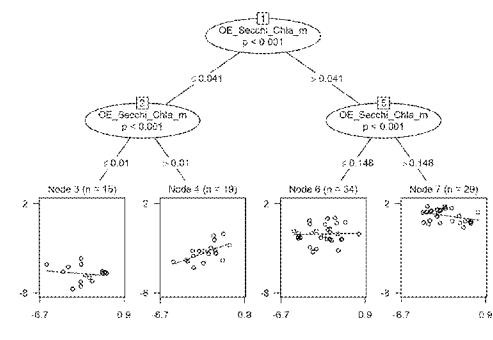
Classification analysis

NON-ALGAL TURBIDITY IS IMPORTANT

Chl ~ TN

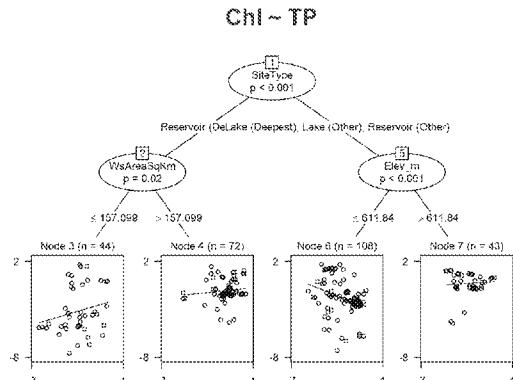
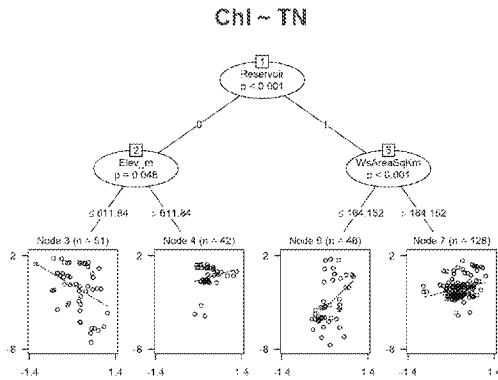


Chl ~ TP



Classification Analysis

REMOVE NON-ALGAL TURBIDITY → ADDITIONAL VARIABLES SPLIT

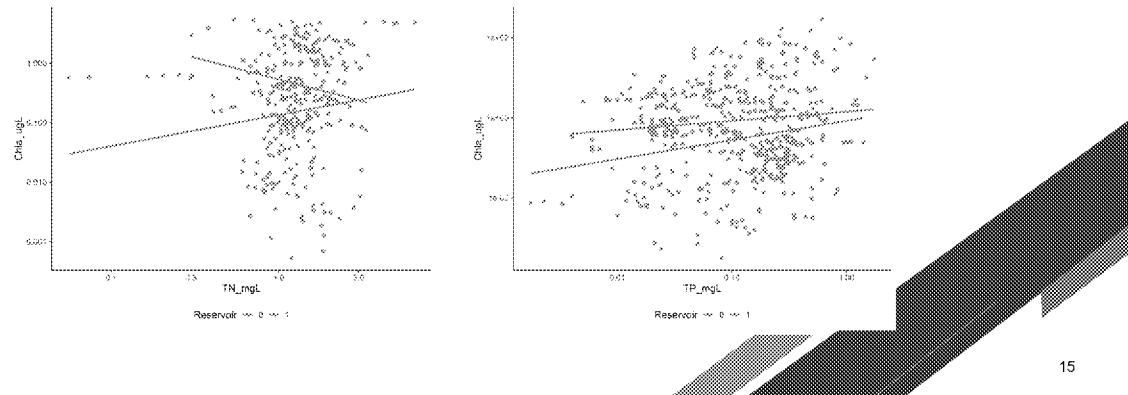




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Classification Analysis

RESERVOIR STATUS: KEY CLASSIFIER VARIABLE



Recommendations: Classification

- Non-algal turbidity was important → use as covariate in models
- MBRP revealed different chl~nutrient relationships → recommend multiple classes
 - Reservoir vs. lake
 - For reservoirs: watershed area ~ 600 km²
 - For lakes: elevation 612 m
 - 2 vs. 4 classes: dependent on management context?



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Overview of Next Steps

1. Classification memo
2. Stressor-Response
 - Test classes
 - ID thresholds associated with adverse responses
 - Evaluate influence of confounding factors
 - Examine impact of averaging period
3. Data Gaps



Planning for stressor-response analysis

- Goal: ID nutrient and chlorophyll thresholds associated with adverse response conditions
- Predictor variables
 - TN
 - TP
 - Chlorophyll
- Response variables
 - Chlorophyll
 - Phytoplankton biomass and assemblage
 - Cyanobacteria abundance
 - pH
 - Dissolved oxygen
- Covariates
 - Land use
 - Non-algal turbidity
 - N:P
 - Thermal regime



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Questions/Discussion